

Remarks

Favorable reconsideration of this application, in view of the above amendments and in light of the following remarks and discussion, is respectfully requested.

Claims 1-21 and 27 are currently pending in the application; Claims 1-21 having been amended, unelected Claims 22-26 having been canceled, and new dependent Claim 27 having been added, by way of the present response.

Applicants express thanks for the Examiner's indication that Claims 16 and 18-21 would be allowable if rewritten in independent form and to overcome a rejection under 35 U.S.C. § 112, second paragraph. In response, Applicants have rewritten Claims 16 and 18-20 in independent form. Dependent Claim 21 depends from newly independent Claim 20. Further, for the following reasons, Applicants respectfully assert that the rejection under 35 U.S.C. § 112, second paragraph, has been overcome. Thus, for at least these reasons, Applicants respectfully request the allowance of Claims 16 and 18-21.

In the outstanding Office Action, the drawings were objected to as failing to comply with 37 C.F.R. § 1.84(p)(5) because they do not include reference signs mentioned in the description. In response, Applicants respectfully assert that original Figures 2A and 2B include reference sign 13.

In the Office Action, the drawings were objected to as failing to comply with 37 C.F.R. § 1.84(p)(5) because they include reference signs not mentioned in the description. In response, Applicants have amended the specification to correct a typographical error and to state "one of the first bumps 110" in place of the previous incorrect statement of "one of the first bumps 120."

In the Office Action, the drawings were objected to under 37 C.F.R. § 1.83(a)

because the drawings must show every feature of an invention specified in the claims. In response, as shown in the attached Replacement Sheet, Applicants have added new Figure 13 showing features of dependent Claim 9. Applicants respectfully assert that support for the new figure is self-evident from the originally filed disclosure, including the original claims, and that therefore no new matter has been added.¹ Further, Applicants have amended the specification to state a brief description of the new figure as well as reference signs included in the new figure.

Thus, for the above reasons, Applicants respectfully request that the objections to the drawings be withdrawn.

In the Office Action, the disclosure was objected to because of informalities. In response, Applicants respectfully submit that page 10, lines 3-9, states by way of non-limiting example that a preferred conductive layer 12 is composed of a copper film, a nickel film on the copper film, and a gold film on the nickel film, thereby stating a conductive layer 12 that includes three films.

Applicants further respectfully submit that the statement on page 10, lines 17-22, of "a top surface of the first bump 10" is understood to include, by way of non-limiting example, a surface that is formed at the top of the first bump 10 that contacts the second bump 20, as opposed to a side surface of the first bump 10, as stated in the specification.

Thus, for the above reasons, Applicants respectfully request that the objection to the specification be withdrawn.

In the Office Action, Claims 1-21 were rejected under 35 U.S.C. § 112, second paragraph. In response, Applicants have amended the claims in a non-narrowing manner as indicated to further the prosecution of the application and to overcome the rejection, and not for any reason related to the patentability of the claims in view of one

¹ Please see, for example, page 10, lines 10-16, of the originally filed specification.

or more references of record in the application, as well as respectfully submit the following remarks.

Regarding independent Claim 1, Applicants have amended independent Claim 1 to recite “[a] semiconductor device comprising . . . a substrate,” thereby clarifying that the substrate is a feature of the semiconductor device.

Regarding dependent Claims 3 and 4, Applicants respectfully assert that the claimed features of “linear expansion” is understood by one of ordinary skill in the art, in view of the specification, to include “linear thermal expansion,”² as suggested by the Examiner. Applicants have also amended the specification to explicitly state “linear thermal expansion (linear expansion).”

Regarding dependent Claim 5, Applicants respectfully assert that the claimed features of “a surface roughness” is understood by one of ordinary skill in the art, in view of the specification, to include a roughness of a surface of a top surface of a first bump 10.³ Applicants further respectfully assert that the claimed features of the surface roughness, by way of non-limiting example, can improve adhesion between a cured resin material 3c and a substrate 1.

Regarding the further statements about dependent Claim 5, Applicants respectfully assert that the claimed features of “a surface roughness of at least a top surface of said first bump” as recited in dependent Claim 5 is not inconsistent with the claimed features of “a first bump obtained by forming a conductive layer on said projection” as recited in independent Claim 1, from which dependent Claim 5 depends. Rather, as stated in the claims, the first bump is obtained by forming the conductive layer on the projection (e.g., the first bump includes the conductive layer on the

² Please see, for example, page 9, lines 2-11, of the originally filed specification.

³ Please see, for example, page 10, lines 17-22, of the originally filed specification.

projection), and the top surface of the thus-formed first bump has the claimed surface roughness.

Regarding dependent Claim 6, Applicants respectfully assert that the claimed features of “a side of said first bump is a conductive-layer free surface, at which a side of said projection is exposed” is not inconsistent with the claimed features of “a first bump obtained by forming a conductive layer on said projection” as recited in independent Claim 1, from which dependent Claim 6 depends. Rather, Applicants respectfully assert that the claimed features of the first bump obtained by forming the conductive layer on the projection does not require that every surface of the projection includes the conductive layer. By way of non-limiting example, Applicants respectfully submit that original Figure 4 shows a first bump 10 obtained by forming a conductive layer 12 on a projection 11 (e.g., the first bump 10 includes the conductive layer 12 on the projection 11), where a side of the first bump 10 is conductive-layer free surface 11a (e.g., the surface 11a of the projection 11 that does not include the conductive layer 12), at which a side of the projection 11 (e.g., the surface 11a) is exposed.

Thus, for the above reasons, Applicants respectfully request that the rejection of Claims 1-21 under 35 U.S.C. § 112, second paragraph, be withdrawn, and that Claims 5 and 6 be examined.

Further, in accordance with the Examiner’s indication of allowable subject matter in Claims 16 and 18-21, Applicants respectfully request the allowance of these claims.

In the outstanding Office Action, Claims 1-4, 7-10, 12-15, and 17 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,789,278 to Akram et al. (Akram). Claim 11 was rejected under 35 U.S.C. § 103(a) as being unpatentable

over Akram. Applicants respectfully assert that the rejections have been overcome for the following reasons.

As stated above, Claims 1-5, 7, 8, 10, 12, and 15-20 have been amended, and new dependent Claim 27 has been added. Applicants respectfully assert that support for the changes to the claims is self-evident from the originally filed disclosure, including the original claims, and that therefore no new matter has been added.⁴

The present invention is directed to a semiconductor device. Independent Claim 1 recites, in part, a pressure holding means for providing a required contact pressure between a first bump and a second bump, wherein the contact pressure is within a range of 28 to 170 N/mm², at which the first bump is in an elastic deformation range, and the second bump is in a plastic deformation range.

Akram is directed to a method for fabricating chip modules. As shown in Figure 2A, for example, of Akram, contact members 16A include one or more projections 44 formed on a tip portion thereof. The projections 44 are covered with an insulating layer 56 and a conductive layer 30. The projections 44 function to compress a conductive adhesive layer 28 and force conductive particles 32 into contact with the bond pads 18.⁵

The Office Action seems to assert that the projection 44, a portion of the bond pad 18, and the conductive adhesive layer 28 are analogous to the claimed features of a first bump, a second bump, and a pressure holding means, respectively, as recited in independent Claim 1. However, even if Applicants agreed with this assertion, which Applicants do not, Applicants respectfully assert that Akram still does not teach the features recited in the independent claim.

⁴ Please see, for example, page 8, lines 14-18, and page 13, lines 16-20, of the originally filed specification.

Rather, because the conductive adhesive layer 28 does not provide a pressure between the projection 44 and the bond pad 18, at which the projection 44 is in an elastic deformation range, and the bond pad 18 is in a plastic deformation range, and therefore also does not provide such a pressure that is within a range of 28 to 170 N/mm², for example, in Akram, Applicants respectfully assert that Akram does not teach the claimed features of a pressure holding means for providing a required contact pressure between a first bump and a second bump, wherein the contact pressure is within a range of 28 to 170 N/mm², at which the first bump is in an elastic deformation range, and the second bump is in a plastic deformation range, as recited in independent Claim 1. Specifically, independent Claim 1 recites “a pressure holding means for providing a required contact pressure between said first bump and said second bump, wherein said contact pressure is within a range of 28 to 170 N/mm², at which said first bump is in an elastic deformation range, and said second bump is in a plastic deformation range.” Thus, for at least these reasons, Applicants respectfully request that the rejection of independent Claim 1 under 35 U.S.C. § 102(b) be withdrawn and the independent claim allowed.

Dependent Claims 2-15, 17, and 21 depend from independent Claim 1, and are therefore also allowable for at least the same reasons as the independent claim from which they depend, as well as for their own features. Thus, for at least these reasons, Applicants respectfully request the allowance of dependent Claims 2-15, 17, and 21.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal Allowance. A Notice of Allowance for Claims 1-21 and 27 are earnestly solicited.

⁵ Column 5, lines 51-61.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact the undersigned representative at the below listed telephone number.



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Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'G. J. Maier', written over a horizontal line.

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Amendments to the Drawings

The attached sheet of drawings include new Figure 13.

Attachment: Replacement Sheet